With the Author's compliments

THE HAMILTON AND BARTON INCLINE RAILWAY.

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In selecting this subject for my paper I am perhaps a little ahead of time, as the railway is not yet completed; however, as the character of the work is something new in this country, a general description of the road, will perhaps not prove uninteresting.

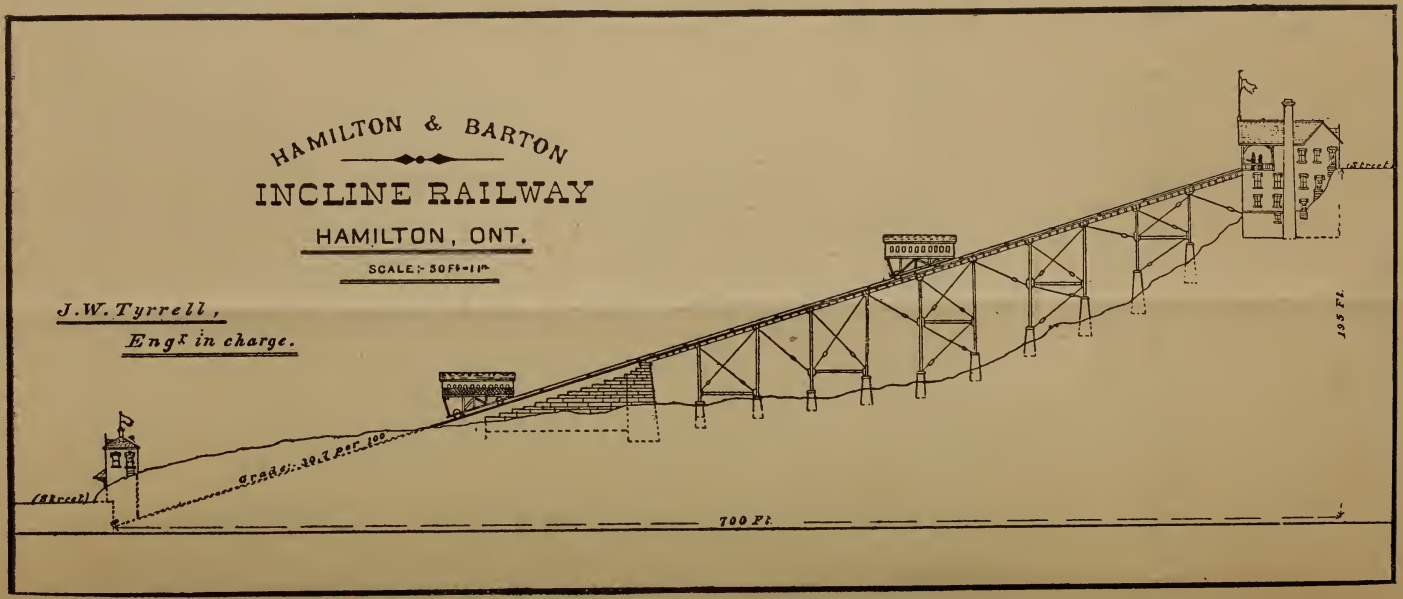
I will not attempt to go into details of construction or the calculation of strains; but will endeavour to convey a general idea of the appearance of the work and its mode of operation.

Those who are familiar with the city of Hamilton relatively to to the back-lying country will readily understand the object and great necessity of some means of facilitating traffic between the city and the rural districts to the south. All along the south side of the city, and extending for miles in either direction, stretches a bold, steep escarpment, commonly called the Hamilton mountain.

The city is built on what has been the beach of Lake Ontario—a strip of land about two miles wide—while the elevation of all the back country is from two to four hundred feet higher. This high table land, which has been cut away in part by the action of the lake, forms the escarpment, which is a very serious barrier to traffic, and though a number of roads have been constructed, and some of them in use for a great many years, leading up the mountain, their grades are so steep—varying from 10 to 15 feet per 100—that ordinary loads cannot be taken up with one team of horses, and light vehicles only with difficulty. The natural result of this inaccessability of the table land from the city has been that, though the most valuable resident property in Hamilton lies along the foot of this escarpment, the property on top, only a few hundred feet distant, is valued at little more than farm land and is very little built upon.

In consideration of these facts and with the object of making our southern suburbs more accessible, a local company, styling themselves the Hamilton and Barton Incline Railway Company, was formed, and secured an Act of Incorporation, which was passed on the 7th of April, 1890.

The greater part of the right of way was secured from the township of Barton over an original side-road allowance. The boundaries of this not being defined upon the ground, our recently departed and


HAMILTON & BARTON
INCLINE RAILWAY
HAMILTON, ONT.
SCALE:- 50 Ft = 1 In.
J.W. Tyrrell,
Engr in charge.
Grade 1 in 2.1 Feet 100
700 Ft.
195 Ft.

highly esteemed brother, F. F. Passmore, was instructed by "the department" to locate them, which instructions he carried out.

Next, the services of an engineer were required, and M. D. Burke, who had built several inclined railways in the United States, was engaged. He visited the ground and prepared the general plans for the road; but not being able to remain in the country the writer was employed to take charge of the construction. His proposition was to construct a straight cable road of uniform grade from a point at the commencement of the rapidly rising ground to the top of the escarpment.

The distance between these two points along the line of location was found to be about 700 feet, and the rise 195 feet. Of this rise 125 feet occur within the southerly 200 feet—that is, nearest the face of the hill; consequently, it was found that by adopting a uniform grade the central portion of the track would be at an elevation of about 50 feet above the surface of the ground.

The design of the company being to provide for the carriage of heavy loads of coal, electric cars, etc., as well as passengers, it would at once seem advisable that the road should be built in a substantial manner, and of materials which would require as few repairs as possible. After a good deal of discussion in order to meet these demands it was decided to adopt stone and steel as far as possible.

Whilst these preliminary, but essential matters were being considered, the writer was engaged in making the right of way surveys, cross-sectioning the ground, etc.; and these all having been arranged and completed, the general plan was prepared which in the main has been adopted, though a great many more or less important changes have been made.

I will now proceed with a description of the road as it is being built:—

It consists of a double track inclined railway. The lower portion of the road-bed is built upon the ground, partly through a cutting and partly upon an embankment formed by the material taken from the cut. The road-bed at the lower end commences in a pit 13 feet deep—that is, 13 feet below the level of the approach to the track.

This pit is formed to receive the peculiar-shaped cars of the road, which are built with level platforms and consequently, to suit the steep grade which is 30.7 per cent., require to be 13 feet high at the one end, the other being as close to the track as possible.

The cutting, which commences with a depth as mentioned, within a very short distance attains a depth of 30 feet. The width of road-bed being 34 feet the amount of material requiring to be excavated was therefore very considerable; and as much of this as could be used with economy was graded up to form an embankment. However, on account of the character of the material—it passing from a stiff clay near the surface to a soft, red rock at the bottom—and the heavy grade of the road, this work was very expensive.

The company having only acquired the right to occupy 48 feet of the side-road, it was necessary to build retaining walls, both to sup-

port the sides of the cutting and those of the embankment, which reaches a height of 25 feet.

The upper end of the embankment is terminated by a heavy stone abutment, built to receive the lower ends of four girders forming part of a steel trestle viaduct.

This abutment is built with large, heavy stone, and provided with wing walls turning back to meet the retaining walls, or rather the retaining walls are extensions of the wings. Some difficulty was experienced in obtaining a good foundation for this stone work, as the ground to a depth of about 20 feet was found to be loose made earth consisting of old boots, ashes, etc. A ravine had crossed at this place, but for years an untiring old squatter had been at work improving this scrap of a road allowance, only to have it taken from him when his task was about completed. In addition to the fact of the ground being loose, a large brick sewer cut through the foundation. This, however, was stepped over with large, flat stones, care being taken to leave plenty of room over the sewer to allow for settlement; and the former difficulty was overcome by excavating until a hard, stiff clay bottom was obtained.

These difficulties were met with again at other points higher up the bank in obtaining foundations for piers to support the steel trestle, which extends over about two-thirds of the length of the railway.

It would take up too much time and space to go into a very full description of this viaduct, but briefly it consists of eleven 30-feet spans and one of 37 feet.

Most of the bents, which are of steel, supported by two stone piers or pedestals, are from 30 to 50 feet in height. They carry four parallel track girders two feet in depth and spread eight feet from centre to centre. The whole structure is designed so that a moving load of 60,000 pounds will not produce a greater strain than 10,000 pounds per square inch of section on any member.

Across each pair of these inclined girders the ties are placed, and upon them, directly over the centre of the girders, the track rails, which are bolted to the girders.

There are then two parallel tracks eight feet from centre to centre of rails and eight feet apart. Upon the bank, below the trestle, the tracks are laid in the ordinary way, except that the ties are supported on the lower side by stout stakes to prevent them from working down hill; and the grade of the whole is as before mentioned, 30.7 feet per 100 feet.

On either track runs a single car 36 feet in length by 14 feet in breadth. The cars, as already intimated, are constructed with level platforms, being supported by wedge-shaped frameworks, which raise the platforms toward the lower end about 13 feet above the tracks.

The cars are combination affairs, being arranged to carry passengers and teams at the same time.

About five feet along one side of each car is covered in to form an apartment, the inside of which resembles the interior of a street car, while the remaining nine feet space is open, being enclosed only by

iron lattice walls on the sides and iron folding gates at the ends, which are opened alternately at top and bottom of the plane to admit of the entrance and exit of teams.

Attached to two heavy timbers, braced by heavy iron knees, in the lower framework of each car, are two steel wire cables, each having a tensile strength of 125,000 pounds by actual test. From the cars the cables are carried up the centre of the tracks on small carrier wheels 14 inches in diameter. To prevent noise and wear of the cables these are made so that they can be packed with leather or rubber.

At the head of the plane the cables pass over large cast iron sheave wheels, 10 feet in diameter (these being strongly supported by iron girders and columns). Thence the draught cable passes down to a winding drum 10 feet in diameter, about 30 feet below, situated in the basement of the depôt at the head of the plane ; but the safety cable passes from the sheave wheels onto another large cast-iron wheel of about equal size, which is set in a heavy iron frame-work and securely anchored to the solid rock, so that in case of the possibility of an accident happening to the draught cable the cars would be held securely by the safety. Powerful brakes are attached at either side of the drum and to the safety wheel, and these may be applied by the engineer from the pilot house.

The foundations of the drum—which itself weighs about 10 tons —are strongly anchored down to the solid rock by 16 two-inch iron bolts.

The drum is controlled, and from it the road operated, by a pair of Wheelock engines of about 125 indicated horse-power.

The depôt, situated at the head of the plane, and which contains all the machinery, is a four storey stone and brick building. The basement is occupied by the engines and drum, the boilers and fuel room, and also contains a large room to be used as a workshop. The second and third flats are designed to be used as a dwelling for the engineer and his family, and the upper flat, which is only on a level with the top of the hill, contains the driving platform, a waiting room, a board room, and a large covered balcony looking out over the city. In the centre of the driving platform and opposite the centre of the tracks is situated the little 4 x 8 feet pilot house. This is built with large glass windows on all sides and commands a view of the whole road. Within it stands the engineer, who has within arm's reach the means of controlling every part of the machinery.

At the lower end of the plane there is another small but neat brick depôt, and dwelling above it for a caretaker. The entrance to this depôt is guarded by sliding gates, which are opened when a car is down. Into the face of the car pit are built four large iron air buffers—two for each car to strike against. These consist simply of 18-inch iron cylinders provided with pistons which are drawn out by wire sash-cords hung with weights and working over pulleys. I have here the general plan of the railway, and a few other plans of various parts of the work for the examination of any who may care to see them.

And now, in concluding this brief description, which I am afraid I have not made as clear as I would like to have, I may add that I will be pleased to give any further information or explanation to any who may desire it.

The road was completed and opened for traffic on the 11th of June, 1892.